(12) UK Patent Application (19) GB (11) 2 102 037 A

(21) Application No 8212323
(22) Date of filing 28 Apr 1982
(30) Priority data
(31) 8113055
8129994
(32) 28 Apr 1981
5 Oct 1981
(33) United Kingdom (GB)
(43) Application published
26 Jan 1983
(51) INT CL³
D04H 1/42
(52) Domestic classification
D1R 105 318 402 403 452
455 503 504 507 508 509
519 520 544 549 557 602
603 641 647 DD DE
(56) Documents cited
None
(58) Field of search
D1R
(71) Applicants
Tay Textiles Limited,
(Great Britain),
Park Mill,
Dundee,
Scotland
(72) Inventors
David McAllister
Harry Wells
(74) Agents
Frank B. Dehn and Co.,
Imperial House,
15/19 Kingsway,
London WC2B 6UZ

(54) **Jute reinforcement of plastics materials**

(57) A jute product for reinforcing plastics materials consists of non-woven chopped jute fibres with a maximum length of 10 cm, preferable 1-2 cm, held together with a binding agent such as PVA adhesive. The product is preferably in the form of a flexible mat of randomly oriented fibres. During production the mat is subject to compression, e.g. between rollers, before the binding agent sets.

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SPECIFICATION

Jute reinforcement of plastics materials

This invention relates to the reinforcement of plastics materials with jute.

The reinforcement of plastics with fibres, e.g. glass or carbon fibres, has been known for many years. Reinforced polyesters, polyurethanes, epoxy or phenolic resins are widely used, with methods of manufacture including moulding and pultrusion. One method of reinforcement involves the use of a chemically bound, non-woven mat of fibres. Suitable binding agents can be PVA, EVA, or Polyester adhesives.

It has been suggested that jute fibres could be used in such a mat. It has however been stated that the natural springiness of the jute fibre prevents adequate compacting of the reinforcement and results in brittle, resin-rich products with a resin: fibre ratio of 5 to 1 or more. This is a particular problem with contact moulding under low pressure, e.g. hand lay-up. Doubts have also been expressed on the strength figures which can be obtained. As a result, commercial applications for jute as reinforcement have been limited and generally restricted to the use of woven jute cloths.

It has now been found that it is possible to overcome these problems and to obtain a jute reinforcement product capable of a wide range of commercial applications.

Thus, viewed from one aspect of the invention there is provided a product for the reinforcement of plastics, comprising a non woven array of chopped jute fibres, having a length of 10 cm or less, held together by a binding agent.

Preferably the chopped fibre length is less than 5 cm, and a preferred range for practical purposes may be 1 to 3 cm. It has, however been found that very short fibre lengths may be advantageous, and depending on the applications, lengths of a fraction of a millimetre might be employed. The practical limit though may be about 0.5 mm.

It has been found that by chopping the jute fibres, which are normally up to 15 cm long, problems with springiness can be avoided. This problem is further reduced by ensuring that in production of the array it passes between pressure rollers or the like after application of the binding agent and before it has set. Such features also ensure that excess resin or the like binding agent is removed, and fibre-rich products can be obtained, with a binding agent content as low as perhaps 4 or 5%. Preferably the content is less than 15%.

As is known, the aspect ratio of fibres used for reinforcement can affect the strength properties. Since however jute fibres are of relatively small diameter, it is possible to chop to fairly short lengths whilst still retaining an adequate aspect ratio.

The binding agent may for example be aqueous starch solution, PVA, EVA or Polyester adhesives, the choice depending inter-alia on the compatibility of th adhesive with subsequent processing steps.

The degree of binding should be such that the fibres are held together in a reasonably coherent fashion, to prevent the array pulling apart to an undesirable extent during subsequent processing steps. On the other hand, the degre of binding and quantity of agent used should not be such that the array becomes too rigid and unmanageable. In particular it is desirable that the array be flexible and capable of being wound on drums and such like, and of course be capable of deformation during subsequent moulding techniques.

The array of fibres will generally be in the form of a mat, strip or tape, although it could for example be in the form of a tube. Generally speaking, the array will be several fibres thick.

Viewed from another aspect the invention provides a method of producing a product for the reinforcement of plastics wherein non-woven jute fibres having a length of 10 cm or less are formed into an array and treated with a binding agent to hold the fibres together whilst maintaining the array flexible.

The binding agent can be applied to both, or to one side only of e.g. a mat, strip or tape of fibres. Leaving one side unaffected by binding agent may be desirable for certain further processsing stages. The application of binding agent can be by means of a spray, by saturation whilst passing between a pair of belts or rollers, by suction application, by bath impregnation or by any other suitable method. After treatment with binding agent, the array may if desired be dried by means of e.g. infra red heaters.

The use of belts or rollers to compress the array, whether whilst applying the binding agent or afterwards, before it has set, has particular advantages.

The array may be wound onto drums or the like for storage, or may be used immediately in the production of a reinforced plastics article.

If desired, the fibres could be aligned, i.e. parallel to each other. It is however felt that, particularly in view of the short fibre length to be used, the invention may be more advantageously applicable in the case of non-aligned fibres. Whilst aligned fibres could be provided by a conventional jute drawing frame with a carding arrangement, non-aligned fibres may be made into a suitable array by means of a a random web forming machine. Both types of machine are well known, as are suitable machines for chopping fibres.

Various additions may be made to products in accordance with the invention to modify or improve their properties. Thus various mixtures of fibres may be used if desired, whether aligned or non aligned. Thus glass fibres would increase strength (although cost as well), and carbon fibres would also increase conductivity if required.

It is considered that the addition of inorganic reinforcement filler materials to mats of jute fibres will hav several advantag s. Such inorganic materials can be deposited and fixed on those areas of the resultant bonded mat where their use will improve the mechanical and physical properties. The deposition of inorganic material of higher stiffness than the fibres, even if only on the surface of the mat, will improv the stiffness of the mat to a significant degre and provid improved mechanical properties in the tensile and compr ssive ar as of the mat.

A particularly advantageous additive has been

found to be mica. Mica has a high stiffness, with its Modulus E being 25×10^6 psi, compar d to 10×10^6 psi for glass and $7 - 8 \times 10^6$ psi for jute. Furthermore, the mica can be deposited in the form of powder or small flakes and easily bonded to the mat. As the mica is plate like its properties are not directional. It is also very water and chemically resistant and it is anticipated that there will be significant improvements in these properties of laminates formed from such composite materials. A particularly advantageous product comprises a mat of random jute fibres with mica plates, and a binding agent such as P.V.A.

An additive which could be used in any of the above products is chalk or another hygroscopic material, in the form e.g. of powder, which will reduce the water absorption of the fibres. Other additives could react chemically to reduce the water absorption, e.g. boratesaul alums.

The provision of additional reinforcement materials such as mica at the stage of manufacturing the mat or the like has a distinct advantage over adding such materials separately to the resin to be reinforced. There are great difficulties in forming composites from fibre reinforcements using resins which incorporate other reinforcements. This is due to filtering action by the array of fibres, and in current practice only small additions of mineral fillers are possible. This can be avoided, and the amount of additional material increased, by combining the fibres and such material before reinforcing the resin.

Thus, preferably means are provided for depositing a dispersion of particles, plates or the like of a secondary material - such as mica - onto the mat or the like either before or with applying the binding agent, or at least before drying the agent.

An example of the invention will now be described by way of illustration only:—

Chopped jute fibres having maximum lengths of 1-2 cm were fed to a random web forming machine which in this case was a "Rando Carlator" (Trade Mark) manufactured by the Rando Machine Corp., U.S.A. The machine produced a web of randomly orientated jute fibres. After leaving the machine the web passed under a hopper full of mica powder or flakes. The hopper was vibrated so that the mica passed down through a transverse slit onto the web. After this the web passed under a spray head which sprayed aqueous starch solution onto one side of the web. A second head could have been used on the other side if desired. The web then passed through a pair of relatively high squeeze nip rollers, working up to e.g. 100 psi, to remove excess solution and compress the web. It was then dried under infra red elements before being wound onto a drum.

The resultant mat was found to be flexible yet coherent and resistant to being pulled apart, as well as being reasonably stiff. It was found to give satisfactory results in the reinforcement of plastics articles, giving reasonable str ngth and stiffness at lower cost and with less weight than using e.g. glass fibres.

In an alternative arrangement for applying adhesive, the web passed over a support in the form of an endless metal mesh belt passing over rollers. Foamed adhesive was sucked through the web from below the support belt by a suitable suction attachment.

Various sizes of mica particles have been used, such as:-

1. Mica flake – 2 mesh to 4 mesh
2. Mica powder – 50 mesh to 100 mesh
3. Mica powder – 100 mesh to 150 mesh
4. Mica powder – 150 mesh to 200 mesh

All four types can be applied by the scattering technique described. In the case of the powder types, however, a different technique can be used. Thus, the mica can be incorporated in the adhesive to be foamed and the scattering arrangement can be omitted. The products in accordance with the invention show particular improvements over known jute and similar products in the field of low pressure contact moulding, e.g. using hand lay up.

CLAIMS:

1. A product for the reinforcement of plastics, comprising a non-woven array of chopped jute fibres, having a length of 10 cm or less, held together by a binding agent.

2. A product as claimed in claim 1 where the fibre length is 5 cm or less.

3. A product as claimed in claim 2 wherein the fibre length is in the range of 1 to 3 cm.

4. A product as claimed in claim 1, 2 or 3 in the form of a mat.

5. A product as claimed in any preceding claim, wherein the fibres are randomly oriented.

6. A product as claimed in any preceding claim, wherein particles of a secondary material are dispersed in the product.

7. A product as claimed in claim 6 wherein the secondary material is mica in the form of powder or flakes.

8. A product for the reinforcement of plastics, substantially as hereinbefore described with reference to the example.

9. A method for producing a product for the reinforcement of plastics wherein non-woven jute fibres having a length of 10 cm or less are formed into an array and treated with a binding agent to hold the fibres together whilst maintaining the array flexible.

10. A method as claimed in claim 9 wherein before the binding agent has set the array is subjected to compression.

11. A method for producing a product for the reinforcement of plastics, substantially as hereinbefore described with reference to the example.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1983.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.